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Salmonella Egg Survey in Hawaii: Evidence for Routine Bacterial Surveillance

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ABSTRACT

One hundred and six dozen eggs, representing 12 brands, were purchased from Oahu supermarkets and cultured for *Salmonella* using standard FDA (Food and Drug Administration) microbiological techniques. Two enrichment incubation temperatures were used to improve culture sensitivity. Ten cartons (9.4 percent) of the 106 dozen samples had shells positive for *Salmonella*. Seven of the 10 were traced to a single egg processor. Inspection of the facility led to the discovery of malfunctioning equipment used in the egg washing and sanitation process. (*Am J Public Health*. 1991;81:764–766)

Introduction

Large outbreaks of human salmonellosis in the United States, related to egg products and cracked shell eggs, led to the passage of the Egg Products Act in 1970. This law required visual inspection of eggs for cracks as well as mandating pasteurization for all bulk egg products.[1,2] Although this legislation led to an initial decrease in egg-related *Salmonella* outbreaks, they have again begun to rise.[2–5]

Contamination of eggs with *Salmonella* can occur in several ways: egg shells may be contaminated by feces[6]; cleaning procedures may be improper[7]; the interior of the egg may be contaminated by the shell being cracked. Contamination may also be internal, prior to shell formation through transovarian transmission.[5,8] In 1989, an Oahu high school student, as part of a science project, cultured two dozen eggs from a supermarket in Honolulu for *Salmonella*. Nine of 24 eggs (37 percent) were culture positive. The high recovery rate prompted the Hawaii State Department of Health to conduct a more definitive prevalence survey for *Salmonella* among eggs for sale in Oahu supermarkets.

Methods

Eggs representing 12 available brands were collected once each week for an eight-week period from June 26 through August 19, 1989. The sampling unit was defined as a carton of 12 large grade A eggs. The carton closest to the aisle was chosen without opening it. Following collection, the eggs were immediately transported to the Hawaii State De-

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TABLE 1—Culture Results of Egg Shells from Ten Dozen Eggs Positive for Salmonella Using Two Incubation Temperatures

Incubation Temp. 35 Degrees Celsius				Incubation Temp. 41 Degrees Celsius			
Dozen	Egg Brand	*Plating Medium	Serotype	Dozen	Egg Brand	*Plating Medium	Serotype
1	K	XLD	Braenderup	1	K	XLD	Braenderup
1	K	BGA	Braenderup	1	K	BGA	Braenderup
				2	K	XLD	Oranienburg
3	J	BGA	Oranienburg	3	J	BGA	Oranienburg
				3	J	XLD	Oranienburg
				4	H	BGA	Mbandaka
5	K	BGA	Cerro				
5	K	XLD	Cerro				
6	K	BGA	Oranienburg	6	K	BGA	Oranienburg
6	K	XLD	Oranienburg	6	K	XLD	Oranienburg
7	K	BGA	Ohio	7	K	BGA	Ohio
7	K	XLD	Ohio	7	K	XLD	Ohio
				8	H	XLD	Havana
9	K	BGA	Oranienburg & Braenderup	9	K	BGA	Oranienburg
9	K	XLD	Braenderup	9	K	XLD	Braenderup
10	H	BGA	Montevideo	10	H	BGA	Montevideo
10	H	XLD	Montevideo	10	H	XLD	Montevideo & Livingstone

*Media = Plating media used: BGA (Brilliant Green Agar); XLD (Xylose Lysine Desoxycholate).

partment of Agriculture (DOA) laboratory for testing. No eggs were damaged, cracked, or visibly soiled.

Of the 12 brands available for study, three were from US mainland producers and nine were locally produced. Fourteen dozen eggs were potentially available each week from each of the 12 brands, as two brands sold both white and brown eggs. Both white and brown eggs were sampled when available. Three brands on some weeks were not available at the designated supermarket locations. Unsuccessful attempts were made to locate these brands at other store locations. A total of 106 dozen eggs were sampled and cultured.

Isolation and identification of *Salmonella* from eggs were conducted using methodology from the US Food and Drug Administration,[9] with one variation. In addition to the recommended incubation temperature of 35 degrees Celsius (C) for samples in tetrathionate enrichment medium, a second incubation temperature (41 degrees C) was used.[10,11]

In order to avoid cross-contamination of samples, glassware was autoclaved prior to and between each use. Individual sterile pipettes and sterile gloves were used, and the pre-enrichment media were autoclaved.

The eggs from each dozen were separated into two flasks; one containing the shells and the other containing the magma (white and yolks). All samples were incubated for 18–24 hours in a lactose broth, pre-enrichment medium.[9]

Samples from each flask were then transferred to two flasks containing tetrathionate enrichment broth. One set of samples was incubated at 35 degrees C and the other at 41 degrees C.[10,11] After incubation for 24 hours, one loopful from each flask (magma and shell) was streaked onto plates of Xylose Lysine Desoxycholate Agar (XLD) and Brilliant Green Agar (BGA).[9] Isolates were serotyped using Centers for Disease Control methods.[12]

Results

Salmonellae were detected in 10 cartons (9.4 percent) of the 106 dozen eggs sampled. Positive samples were from shells only. *Salmonellae* were detected in samples from only three of the 12 brands examined. The brand with the highest weekly prevalence (6/8) was locally produced; the second highest (3/8) was a mainland brand; while the third highest (1/8) was a local brand.

Use of two enrichment incubation temperatures resulted in improved *Salmonellae* isolation rates. Three of the 10 dozen eggs testing positive came only from the enrichment medium incubated at 41 degrees C. One positive sample came only from the enrichment medium incubated at 35 degrees C. The remaining six dozen positive samples grew at both temperatures. Serotypes *braenderup, oranienburg, mbandaka, cerro, ohio, havana, montevideo,* and *livingstone* were detected (Table 1).

Discussion

An earlier egg survey done in Hawaii[13] as well as surveys conducted in New York,[14] Missouri,[15] British Columbia, [16] India,[17] and Saudi Arabia[18] demonstrated the prevalence of *Salmonella* on the surface of washed, commercially processed egg shells to be 0–2 percent. However, these surveys used only a single enrichment incubation temperature.

The use of two incubation temperatures for the enrichment medium increased the sensitivity for *Salmonella* detection in the present study. *Salmonella* would have gone undetected in three of the 10 dozen eggs had only the standard incubation temperature been used.

The US mainland brand eggs testing positive for *Salmonella* were traced to a USDA supervised plant in California. Upon inspection, no deficiencies were observed in this plant. The two brands of locally produced eggs were traced to one processor and a single farm. As a result of this study, the Hawaii State DOA inspected the processing plant. Equipment used in the egg washing and sanitizing process was found to malfunction. The company voluntarily agreed to cease operations until the deficiencies were corrected. The eggs were diverted to another facility for processing pending repair of the defective equipment. To date, the facility has not resumed operations as an egg processing plant. It is currently being used as a storage facility (personal communication DOA).

Recent reports of egg-associated salmonellosis have incriminated Grade A shell eggs that were considered to have been properly processed.[2–5,8] While transovarian transmission has also been implicated as a possible cause for the resurgence in egg-borne salmonellosis,[5,8] deficiencies in egg-processing procedures may be of more importance.

In Hawaii, the state DOA is the only state agency with regulatory authority over the egg industry. However, the scope of its activity is limited to the structural integrity of the eggs. Currently, there are no regulations that mandate active surveillance and monitoring of eggs for bacterial contamination. Our data indicate that visual inspection of eggs is not enough. Ongoing egg bacterial surveillance with im-

proved laboratory methods, including the use of two enrichment incubation temperatures to increase *Salmonella* culture sensitivity, would allow for early detection of deficiencies in egg handling and processing, and could eliminate *Salmonella* egg contamination as a potential cause of disease in the community. □

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A B S T R A C T

Analysis of 1980-1985 death certificate data for the United States indicated that an average of 369 occupational deaths per year involved agricultural machinery as the external cause of death. Out of all agricultural machine-related deaths, tractors accounted for 69 percent. Over half of these tractor-related deaths were rollovers. There is a need for public health programs to affect greater use of rollover protective structures (ROPS) on farm tractors. (*Am J Public Health.* 1991;81:766–768)

Agricultural Machine-Related Deaths

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Introduction

Fatalities among farm machine operators present a conspicuous injury target for public health action.[1–3] Farm tractors are known to be particularly deadly,[4–6] but prevention programs appear to be floundering.

As a first step toward the establishment of priorities for fatality prevention programs in agriculture, we decided to examine the National Traumatic Occupational Fatality (NTOF) data base maintained by the National Institute for Occupational Safety and Health (NIOSH).[7,8] Previous analysis of NTOF data for the years 1980-85 had shown that the Agriculture, Forestry, and Fishing industry had a fatality rate of 20.7 per 100,000 workers, a rate 2.6 times higher than the national average for all industries of 7.9 deaths per 100,000 workers.[7]

Methods

Death certificate data in NTOF were reviewed to identify persons killed while working with machines. Machine-related fatalities were identified by codes E919.0 to E919.9 according to ICD-9. Next, the type of machine involved in each machine-related fatality across all United States industries was ascertained by reviewing the description of the cause of death on the death certificate. All agricultural tractor-related fatalities were then categorized and compared by the Standard Industrial Classification (SIC) for the industry in which the incident occurred.[9] Age at death was determined for those fatalities associated with tractors, augers, hay balers, combines, and other agricultural machines.